Free Flight Issues from an AOC Perspective

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Based on our studies at AOCs (Airline Operations Control Centers), ATCSCC (Air Traffic Control Systems Command Center), and TMUs (Traffic Management Units), we have identified a number of principles to consider in guiding the design of a future Air Transportation Management System. These principles, along with supporting examples, are outlined below.

Principle 1. Decisions to make changes in policies and procedures, and to introduce new technologies, should be made on the basis of their potential to increase efficiency and reduce costs for the airlines, while maintaining or enhancing safety. These improvements could be due to increases in system capacity, or to improved use of existing capacities. Such decisions should be evaluated in terms of the cost effectiveness of these changes.

Example: Data from one major airline indicates that the increased flexibility in flight planning provided during the first three months under the expanded NRP allowed its dispatchers to file flight plans with the potential to improve fuel efficiency by 1.5% - 3.5% (Smith, McCoy and Orasanu, 1995). To more effectively take advantage of such improvements, this airline will need to enhance its flight planning software. In addition, new ATM and ATC procedures and/or support technologies will have to be introduced to support the resultant changes in traffic patterns and densities. In assessing the benefits from the expanded NRP, each such expenditure by an airline or by the ATM/ATC system should be evaluated in terms of its cost effectiveness. (Similar considerations are likely to arise in the implementation of more advanced free flight environments.)

Principle 2. Provide the users with opportunities to explore alternative flight plans, schedules, etc. in order to identify areas for improved efficiency or reduced costs.

Example: The value of this approach has been illustrated by the introduction of the LAH/MAR (limited airborne holding/arrival reservoir) program at Philadelphia. Prior to the changes in policy regarding limited airborne holding at that airport, there were significant restrictions on traffic levels. When the airlines were given the opportunity to experiment with the use of arrival reservoirs, it was discovered that the restrictions at Philly were unnecessary, and that Philly could accommodate the traffic levels desired by the airlines without restrictions. Consequently, those restrictions have been removed.

Principle 3. Develop an ATM system that offers the airlines flexibility, but that is also predictable.

There are numerous factors that determine the best flight plan for a particular flight. These include factors such as passenger connections and crew schedules, as well as fuel burn (Beatty, 1995). Airline AOCs are in the best position to evaluate these factors and to make a business decision as to whether and when to launch a flight, and as to the route of flight (subject to constraints such as safety and capacity).

To make such decisions, however, airline AOCs also need a certain level of predictability regarding system capacities (along high altitude routes, arrival fixes, runways, gates, etc.). Just as with weather forecasts, predictable limitations and bottlenecks need to be communicated to the AOCs, so that these can be taken into consideration in making decisions about routes, fuel reserves, etc.

Example: At certain times of the day, traffic from the west into the northwest cornerpost at Chicago is very heavy. Consequently, this traffic is sequenced to ensure efficient landings at the airport. When one particular airline wants to file flights from Minneapolis to Chicago, it is consequently told that it has a choice such as:

You can take a 20 minute ground delay and then be assured that you can be sequenced into the flow at the northwest cornerpost, or you can take off now with a 20% chance of being fit into that sequencing and an 80% chance that you will be vectored to the northeast cornerpost instead.

With that information, this airline has the flexibility to make its own business decision and to plan appropriate fuel reserves, etc. Although an advanced free flight environment may offer more choices and

flexibility, as in this example, when choices have to be made AOCs need to be informed about the various options and their implications.

Principle 4. Develop an ATM system that assumes traffic levels, traffic patterns, etc. will change and evolve over time, and that can adapt to these changes.

Example: In Principle 2 above we discussed the success of the MAR program at Philadelphia. In soliciting reviews of this document prior to its release, we got the following additional input from one TMO:

"Cleveland Center has seen a noticeable increase in holding for Philadelphia. I do not know if this is attributable to MAR or not. I also do not know what the cost is to the airlines. However, in a busy enroute environment there are many 'ripple' effects from high altitude holding. Numerous other aircraft are routed around holding stacks, kept at lower altitude, or even delayed off the ground while controllers adjust to being shut off and making the transition to the hold. I believe these 'hidden' costs, along with the cost of holding, and safety concerns make enroute holding an undesirable option."

In terms of Principle 4, the point of this example is that the ATM system must be constantly viewed from a process control perspective, looking for changes in performance that require new adjustments.

Principle 5. For a new program or procedure to be effective, all participants need training to understand the nature of that program. Otherwise, instead of working cooperatively, these individuals may be working at cross-purposes.

Examples: One of the problems associated with the rapid implementation of the expanded NRP (National Route Program) in January, 1995 was that some airlines were not prepared to train their staff adequately. Interviews with pilots from several airlines, for example, have indicated that they do not know when they are flying a flight plan filed under the expanded NRP. Further investigation revealed that this information is being coded on the flight plans given to these pilots. The pilots simply haven't been trained adequately to know where to find the information.

This problem has clear implications for success of the expanded NRP, as a pilot should be much more cautious about significantly changing a flight plan while enroute if it has been filed under the expanded NRP (since that was the AOC's best estimate for the preferred route of flight). If the airline trusts these AOC-generated plans, then the pilot should not, for example, be refiling direct from BOS to LAX if the original flight plan had a significant deviation south as part of the route filed under the expanded NRP. The exception would be when the pilot (in consultation with the dispatcher) knows that weather or traffic conditions have changed significantly since that pre-flight plan had been generated.

A second example is even more telling. As noted in another of our reports, a by-product of the expanded NRP has been a sizable increase in the number of direct flights approved while enroute. One of the pilots interviewed from a major air carrier indicated that he thought "that was what the expanded NRP was all about", that when a controller now offered him a direct flight, ATC and the AOC had jointly determined that a direct flight was best for him in terms of weather and air traffic. His comment was: "I was tremendously impressed that they could achieve such coordination." (The reality is that such offers for direct flights have been completely uncoordinated— the controllers haven't even been checking with the other affected Centers, let alone the airlines, regarding the impact of such direct flights.)

Principle 6. Flight planning is a distributed, cooperative problem-solving task. It is therefore essential that the participants communicate easily and effectively with each other, and develop a mutual understanding of the goals and constraints facing each other.

Principle 6a. In addition to formal training, it is important to develop procedures so that the knowledge necessary to work together efficiently and effectively continues to be distributed to all of the participating individuals.

Example: The system for requesting non-pref routes through ATCSCC under the old NRP (advisory circular 90 91) provides an effective example of how procedures can be established to encourage the distribution of knowledge to relevant participants in the flight planning process. As one airline ATC coordinator stated (Smith, McCoy, Orasanu, et al., 1994): "When we started this [the procedure for requesting non-pref routes], even Central Flow didn't know where all the choke points were. But as we pressed the system and said 'now we want to fly over here', we'd call the Albuquerque Center and they'd say: 'Well, you can't go eastbound over St. John at 4 o'clock in the afternoon.' Well, that was tribal knowledge in the Albuquerque Center. The tribe expanded to include Central Flow; Central Flow expanded the knowledge to the airlines and we [the airlines] began to build better routes. So rather than having to fly a 2000 mile route because it didn't work at one point, we began joggling around and making routes that were smarter. ...Originally, we'd call and they'd say no. But then it became: 'Well, if you would just do this, if you'd just make this minor adjustment in your flight plan, we could probably do this. It became a much more collaborative effort."

Again, one goal of an advanced free flight system is to reduce certain bottlenecks and constraints. But, when they exist, it is important to develop a system where this knowledge is propagated to the AOCs so that they can make informed decisions.

Principle 6b. Provide the individuals who are actually making decisions with the real time information necessary to predict the implications of those decisions.

Example: Problems resulting from a failure to distribute information are illustrated by a scenario which developed as a result of the initiation of the expanded NRP. At 10 am, New York informed Cleveland and Chicago Centers that they expected a major reduction in capacity until 2 p.m. Chicago and Cleveland began to limit and reroute traffic that was filed on the pref routes. However, under the rules of the expanded NRP, flights so filed are supposed to be left alone unless there is a clear safety concern. As a result, a number of West Coast flights filed under the expanded NRP were allowed to continue without modification. This resulted in excess arrivals at New York, and a need to put flights into undesirable high altitude holding patterns, something that both traffic managers and dispatchers felt could have and should have been avoided by providing the AOCs and flight crews with more timely information so that they could have worked out a better solution with the ATM/ATC system.

Principle 6c. Provide timely feedback to the individuals who are actually making decisions.

Principle 6d. Because of the need for participating individuals to maintain situational awareness, sup tools should be designed to keep these individuals "in the loop" and to assist in the development of consistent mental models among the individuals who are working in cooperation at AOCs, in the cock and in the ATM/ATC system.